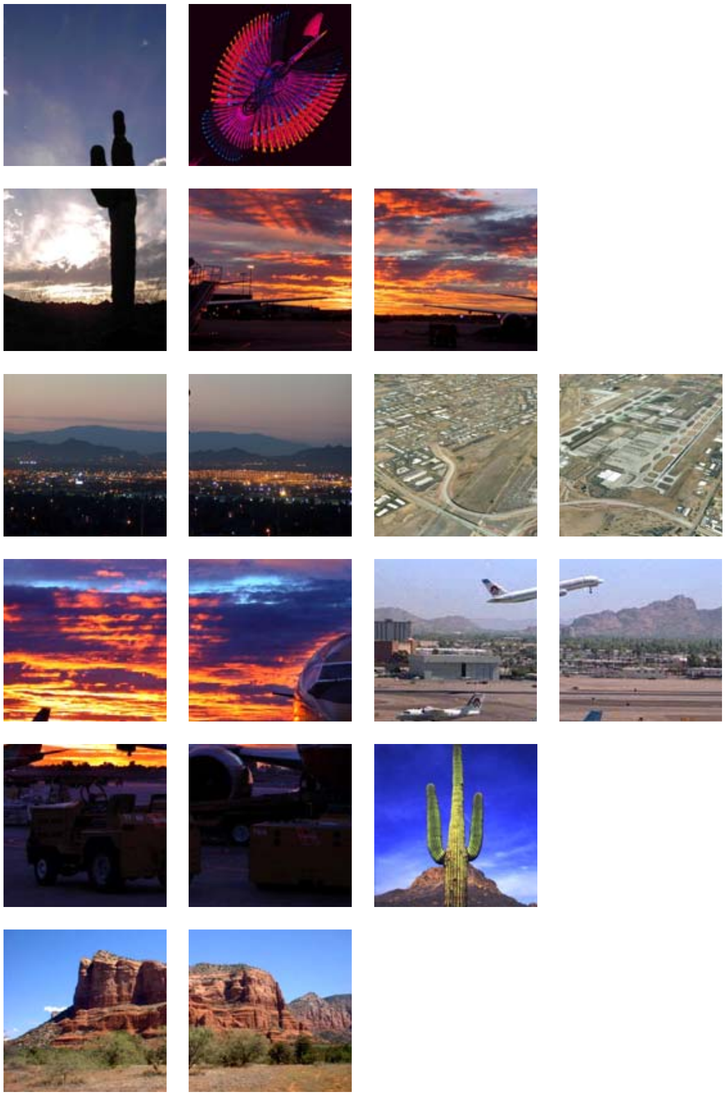


Section 5

Available Technology

Section 5 Available Technology

This section outlines the facility components and technology available to develop today's Regional ARFF Training Facilities.

The fuel chosen to create the live fires determines the technological aspects of the ARFF training facilities. Traditionally, ARFF training facilities had been designed for flammable liquid hydrocarbon (FLH) fuel use. This fuel provides for a more realistic aircraft fire simulation. Today, however, the largest number of training facilities built for aviation firefighting and structural firefighting training are constructed using propane liquefied gas as the preferred fuel, largely due to safety and environmental reasons.

5.1 Facility Components

In accordance with FAA Advisory Circular 150/5220-17A, Design Standards for an Aircraft Rescue and Firefighting Training Facility, an ARFF training facility consists of the following components:

- Burn area structure;
- ARFF vehicle maneuvering area;
- Support components; and
- Support systems.

As its name indicates, the burn area structure is the component of the training facility where live fire exercises are conducted. The size of the burn area is determined by the greatest ARFF index training to be conducted at the facility. The basic design concept of the burn area structure is a containment area for the fuel and extinguishing agents.

The ARFF vehicle maneuvering area surrounds the burn area structure and should be large enough to allow multiple vehicles and operators to coordinate and practice firefighting strategies and tactics.

The support components for the burn area structure include crushed stones, an aircraft mock-up, concrete apron, and an overflow drain.

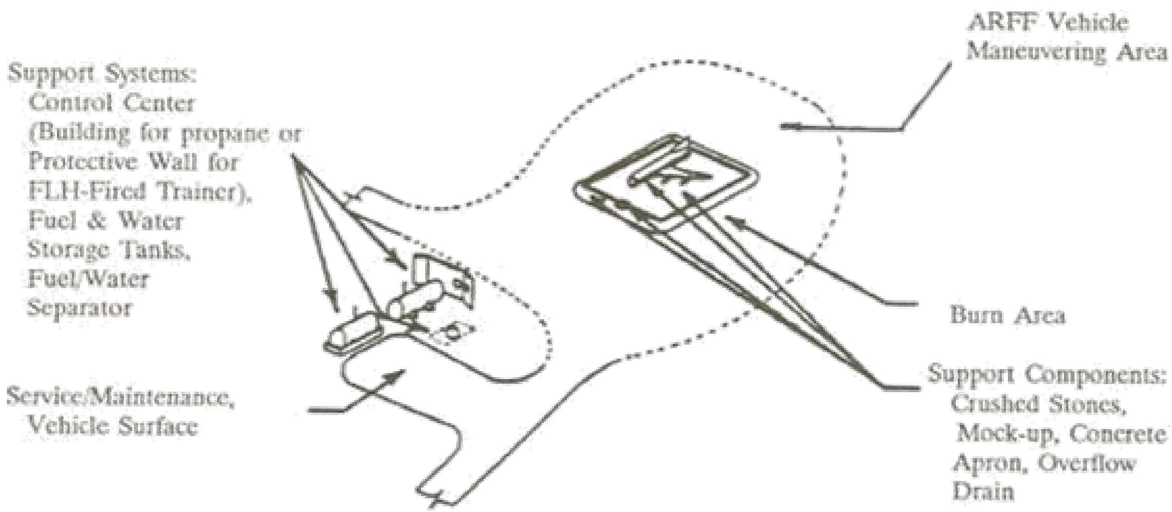
The support systems for the ARFF training facility can include the control center building or protective wall, fuel distribution system, water distribution system, and a fuel/water separator.

Exhibit 5.01 below shows the FAA's generic facility layout.

Other ARFF training facility components not specific to the live fire exercise include classrooms, locker rooms, automobile parking, storage buildings, and other items to enhance the learning environment.

Exhibit 5.01

Generic ARFF Training Facility Layout



Source: FAA AC 150/5220-17A

5.2 Types of ARFF Training Facilities

There are three types of ARFF training facilities:

- Flammable Liquid Hydrocarbon (FLH);
- Propane; and
- Mobile Trainers.

The three types of facilities are further described below.

5.2.1 Flammable Liquid Hydrocarbon (FLH)

Flammable Liquid Hydrocarbon (FLH) facilities can provide a realistic training scenario. The burning of hydrocarbon based fuels such as gasoline, diesel, and jet fuel generate large amounts of smoke in the process. This alone can be the biggest issue for a hydrocarbon facility. Fitting into a community and getting the public to accept the amount of heavy black smoke generated during a training exercise can be very arduous. Exhibits 5.02 and 5.03 show FLH training simulations. Even after FLH facilities are built, the number of times a year a full-scale burn can occur can be restricted due to local constraints.

As an alternative to reduce the level of black smoke, the floating of a layer of fuel onto the surface of water reduces the amount of fuel required to do a large-scale burn. Unfortunately, once the fire is started it must burn out or be extinguished. Safety concerns are an issue with this approach during burn exercises since the fire cannot be extinguished immediately. Safety crews must be suited up and ready to go into the pit in the event of an emergency with this approach.

Exhibit 5.02

FLH Training Simulation

Exhibit 5.03

FLH Training Simulation

Emissions from a hydrocarbon burn include large quantities of Nitrogen Oxide (NO^x), Carbon Monoxide (CO), Carbon Dioxide (CO^2) and partially-burned Hydrocarbons (HC) within the smoke plume that is carried away from the facility.

Improvements to hydrocarbon technology include chemically modified fuels. When these modified fuels are burned, the smoke output is reduced and the fire can be put out with existing extinguishing agents. Some hydrocarbon facilities are now utilizing these fuel modifiers to limit the output of undesirable heavy smoke particulate created in the combustion of the hydrocarbon fuels. These fuel modifiers can be added to existing stockpiles of training fuels to reduce smoke output.

In 2001, the Federal Aviation Administration (FAA) tested two fuel modifiers at its William J. Hughes, Technical Center located in Atlantic City, New Jersey. The FAA compared the emission by-products of traditional JP8 fuel with the new fuel products specifically designed for firefighting training.

> *"The new products compared in this evaluation are highly refined hydro-carbon based fuels that significantly reduce the smoke output and dissipate more rapidly. In addition to the smoke output, the comparison testing also addressed residues left in the water used during the training. The residue consists of unburned fuel and partially combusted byproducts…Both of the new training products showed major improvements in reducing the production of environmentally harmful by-products."*[5]

Texas A&M, Boston Logan Airport, and Norfolk International Airport are all facilities that are successfully using modified fuel additives to reduce the smoke output of the facilities. Exhibit 5.04 shows the low particulate smoke output of Jet A fuel modified with a smoke reducing fuel additive and tested on the FAA's three-dimensional running fuel cascade.

Fire demonstration tests conducted by the FAA at the William J. Hughes Technical Center were very successful in reducing off-site heavy smoke plumes. As is seen in the previous exhibits, there is a large reduction in the quantity of heavy particulate generated by using a smoke reducing fuel additive.

[5] DOT/FAA/AR-TN01/4, Federal Aviation Administration, William J. Hughes Technical Center, "Aircraft Rescue and Firefighting Training Fuel Comparative Evaluation", Keith Bagot, February 2001.

Exhibit 5.04

Training Simulation with Smoke Reducing Fuel Additive

5.2.2 Propane

Many training facilities built for aviation firefighting and structural firefighting training are constructed for use of propane liquefied gas as the preferred fuel. This is due to environmental and community concerns regarding the operation of the facility. Propane liquefied gas facilities have strong safety records due to the ability to immediately suspend training exercises should an emergency arise. This can be accomplished by interrupting the gas flow with inline controls to immediately shut down a fire by starving it of fuel.

Propane is generally used for interior fire fighting due to safety concerns where the size and duration of the fire can be controlled. It would be much more difficult to develop an interior trainer using hydrocarbon fuels. In an interior fire, the seats and other combustible Class A materials are all made of steel. This allows the trainer to be reused and recycled for training.

In addition, hydrocarbon fuel would not naturally be in the interior of an aircraft. If a hydrocarbon fire source was used in the interior, there would be a large build-up of unburned hydrocarbon fuel or heavy soot build-up within the mockup generated by the hydrocarbon smoke. If firefighters were to get this heavy black soot on their fire ensembles, they would have to be professionally cleaned after their training cycles, increasing the already expensive cost of attending a training facility.

Exhibit 5.05

Propane Burn Pit Training

Exhibit 5.06

Propane Nacelle Fire Training

Large-scale propane-based training simulators are used by some of the world's busiest airports for worst-case aircraft emergency training. Large-scale facilities can be found at the following international airports: Chicago, Dallas-Fort Worth, Dulles, Philadelphia, Rochester, Kennedy, and Heathrow (England).

The use of natural gas is generally considered when it is locally available and abundant in quantity. More typically, natural gas will be found in use when a structural facility is incorporated into a city urban environment and underground gas supplies are already present. Piping of the fuel source underground to the site eliminates transportation concerns as well as storage concerns. Natural gas pipelines are not generally sized to flow the additional quantities of fuel necessary to service a large-scale airport pit fire. The large draws of gas quantity needed to fuel a large pit could cause safety problems for down stream users. On the other hand, natural gas works well in structural facilities where the fires are generally small and require very little gas quantity for the fire simulator. There have not been any large airport facilities built to date that use natural gas for their fuel source.

5.2.3 Mobile Trainers

Smaller, mobile trainers have been developed and are being used for firefighting training. These smaller systems, sized to the commuter aircraft market, allow over-the-road transport and allow the firefighters to utilize their own firefighting equipment during the training exercise. Mobile trainers can be brought to the airport and set up in different locations.

Mobile systems incorporate many of the fixed trainer features, without the need for complex infrastructure. The fully self-contained system is easily transported by roadway tractors allowing an ARFF training capability to be shared among smaller index airports. The system must be fully compliant with FAA Training Guidelines. Virginia, West Virginia, and the University of Maryland each have mobile simulators that travel from airport to airport within their states. The United States Navy has purchased fourteen mobile trainers for aircraft carrier shipboard fire fighters and Naval Air station firefighter training.

These States felt that they needed a facility that could be transported rather then fixed at one location since many of the airports in their states had small departments and could not send their people away to receive their training. In each case, the State Department of Transportation supplements the cost of the transportation of the mobile trainer.

Mobile systems require the transportable system to have some sort of portable fire arrangement for the pit fire. An example of this kind of trainer would include a shallow water pan with a fine mesh metal grate material that allows firefighters to pull hoses and walk across the fire pans and computer thermal sensors to detect agent application rates from the hose line or ARFF truck. In addition, interior fires can be conducted along with several specialized fires such as a brake/wheel fire.

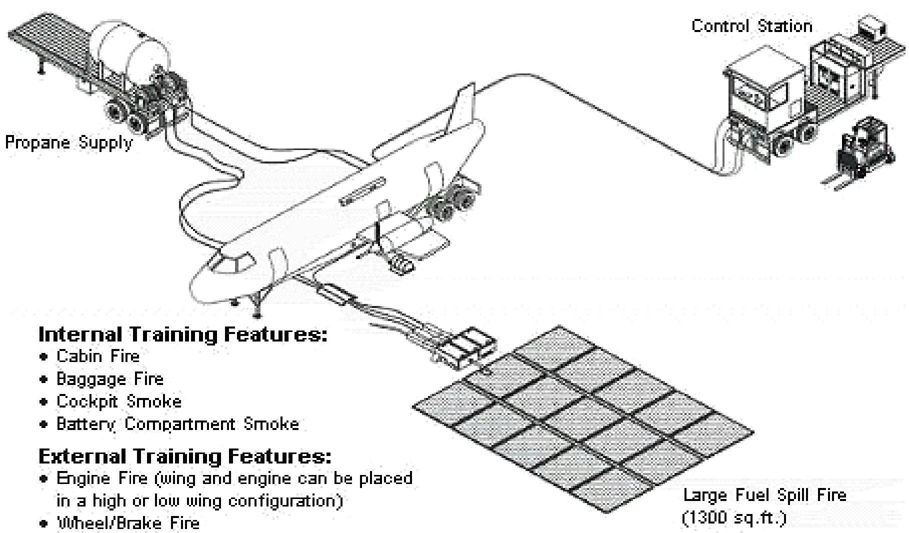
In the mobile system, the simulator fuselage is sized to be a commuter type aircraft of approximately 1,300 sq ft. Pans or mat material are carried within the trailer fuselage along with additional trailers and the control facility. All of the transportable system is sized to meet the

U.S. Department of Transportation (DOT) over-the-road guidelines. The trainer does not require special permitting to be transported. A generic mobile ARFF Training System is shown in Exhibit 5.07.

To fuel the mobile system, propane is contracted on an as-need-basis from a local propane provider. This eliminates the need to transport the fuel with the trainer and avoids U.S. DOT highway restrictions and permit requirements. The fire size can easily be expanded to replicate a large spill fire; it is just a matter of how many trailer transporters are needed to carry the additional equipment necessary to expand the fire size.

Exhibit 5.07

Generic Mobile ARFF Training System



5.3 Comparison of ARFF Training Systems

The characteristic visual difference between an FLH burning fire and a controlled propane fire is the substantial reduction in pollution emissions and more rapid dissipation of the smoke with a propane system. While smoke emissions are reduced with the use of propane, they are not eliminated. The propane smoke cloud is virtually fully dissipated before it drifts across the boundaries of the training facility, yet the presence of smoke provides the firefighter with a realistic appearance similar to a jet fuel fire.

Table 5.01 below shows a criteria comparison of the three types of ARFF training systems; Flammable Liquid Hydrocarbon (FLH), Propane, and Mobile Trainers.

Table 5.01

Comparison of ARFF Training Systems

Criteria	FLH	Propane	Mobile
FAA Requirements	+ Meets	+ Meets	+ Meets for Index A and B airports
Technology History	+ Standard technology prior to 1992 + Fuel modifiers help to reduce smoke levels	- New technology since 1992	- New technology since 1993
Training Value	+ Very realistic for heat, flames, smoke, extinguishing requirements	- Realism simulated with burners, sensors and automated/manual controls; unrealistic smoke levels	- Similar to propane
	- Turnaround time between fires governed by refueling rate, problems with reignition and water level adjustments	+ Minimal time between fires	+ Same as propane
	- Specific fire size, location and duration difficult to control	+ Size, locations and duration of fire controlled by computer or manually	+ Same as propane
	+ Water and/or water/foam mixture used as extinguishing agents	- Foam usually not used; surrogate foams available	- Same as propane
	+ Teaches realism	+ Teaches techniques	+ Same as propane
	- Interior space training very limited	+ Interior space training conducted	+ Same as propane
Maintenance and Repairs	- Burn area concrete cracking/spalling and igniter malfunctions common problems	- Complex system of burners, igniters, sensors and valves controlled by computer requires specialized service	+ Maintenance, repairs and upkeep accomplished by equipment owner
Operation	- Requires upkeep - Requires experienced operator	- Requires upkeep - Requires trained operator	- Same as propane
Safety	- Fire must be extinguished with water or foam	+ Fire controlled by computer, trainer and/or emergency shut off	+ Same as propane

Criteria	FLH	Propane	Mobile
Environmental			
Air Quality	- Dense, black smoke highly visible for long distance and duration	+ Smoke visible, but not for long distance or duration	+ Same as propane
	- Other air pollutants emitted in moderate quantities	+ Other air pollutants emitted in smaller quantities	+ Same as propane
	+ Unlikely to cause violation of AAQS	+ Very unlikely to cause violation of AAQS	+ Same as propane
	+ SIP conformity determination likely not required	+ SIP conformity determination not required	+ Same as propane
Soil/Surface Water and Groundwater	- History of causing contamination from spills and/or leaks	+ Not expected to cause contamination	- Same as propane
Wastewater	- Requires treatment with catch basin, oil/water separator filters and/or waste water treatment plant	+ Non foam or fuel containing water requires no treatment	- Same as propane
Permits	- NPDES for off-site disposal of wastewater (w/o public sanitary sewer); and construction	- NPDES for disposal of wastewater (w/o sanitary sewer); and construction	- Same as propane
	- Open burn permit (minimal) - Aquifer protection permit	- Open burn permit - Aquifer protection permit	- Open burn permit
Other Potential Limitations	- Dense, black smoke may be objectionable in some areas and less acceptable to regulatory agencies	- Construction costs significantly more than hydrocarbon facilities	- Currently limited to Index A and B airports - Available by rental only - Cannot simulate pool fires

Sources: The Louis Berger Group, Inc.
Greiner, Inc. – 1995 – *Feasibility and Environmental Review for a Regional ARFF Training Facility*

Notes: + denotes positive attribute
- denotes negative attribute

5.4 Characteristics of Large-Scale ARFF Training Facilities

Large-scale airport based facilities provide regional ARFF training capability to airports that can commute to the fire training facility, while affording the host airport the advantage of training while using their own firefighting trucks and equipment.

Large-scale ARFF training facilities generally include a fire pit based on the largest aircraft Index E of the FAA. Typically, facilities have a 152-foot diameter simulated spill pit with a steel mock-up including a broken wing. A large-size training pit allows the facility to offer training for all airport indices. In addition, a Specialized Aircraft Fire Trainer (SAFT) is usually present that can produce an assortment of specialized fires. These fires include a cargo fire, wheel well, wheel brake, auxiliary power unit (APU), electrical system, cockpit instrumentation fire, galley fire, and interior fires. When the facility contains both a SAFT and the large pit, simultaneous training can occur, maximizing the training experience for the firefighter by simulating different fire scenarios.

Large-scale facilities typically include at a minimum a training classroom that can be broken down into smaller classrooms for small group discussions, workgroups, and critiques; a control tower to oversee the safe operation of the facility; and showers and locker rooms. Larger facilities utilize multiple major rescue vehicles to practice team responses and coordinated fire attacks. Due to the large number of self contained breathing apparatus (SCBA) bottles utilized in the course of a day's training, an air cascade or recharge system is part of the facility. A small medical emergency room or clinic is a component of the facility and is staffed with trained emergency medical personnel.

In addition, many large-scale facilities team with educational institutions such as community colleges, colleges, or universities. These alliances allow firefighting training to be eligible for college credit towards a degree. This is helpful when career promotions and advancement are a consideration. Conducting advanced training, hosting firefighting conferences, and conducting community emergency and mutual aid training exercises all dictate that facilities will generally have the ability to host as many as one to two hundred people at a time.

5.5 Additional Considerations, Examples and Products

5.5.1 Environmental Considerations in Choosing Technology

While realistic training is paramount, proper steps should be taken to ease the burden on the environment. The training systems should have minimal environmental impact and relieve community and legislative concerns of air pollution and water contamination. Trainers fueled by natural gas or propane are both available today and most of the large-scale airport training facilities utilize propane. These clean burning fuels do not produce the levels of black soot and volatile organic compounds (VOCs) that conventional fuel generates. The system's simulated smoke is environmentally benign and water run-off from the trainer can safely be discharged into conventional sewer systems without treatments.

Groundwater contamination is a major concern of firefighting training if proper control measures are not employed. Containment measures such as heavy duty vapor barriers or liners within the training facility area can prevent extinguishing agent and fuel from leaking into the ground. Major rescue vehicles used today can throw extinguishing agent over 200 feet. This means that a large area well beyond the fire pit's circumference must also be within the protected spill area.

The fuel mock-up site and fuel storage containers should be located within containment areas. Additional environmental safeguards include curbs for spill controls, secondary containments and leak detection systems. ARFF Training Facilities utilize groundwater monitoring wells to periodically test the water for contamination.

The large quantity of water that is generated during firefighting training exercises is usually collected and stored in large holding ponds or containers where it must be treated prior to reuse or discharge. A water/fuel separator, or a more advanced wastewater treatment system treats the wastewater to an acceptable level for reuse or discharge. This process separates the unburned fuel and chemical agents, allowing the recycled agents and fuel to be reused for firefighting training. The recycled water from this process is collected in a holding pond for reuse.

5.5.2 Examples of Training Facilities

Table 5.02 on the next page shows FAA grant funded ARFF training facilities.

Table 5.02

FAA Grant Funded ARFF Training Facilities

Location	Type Facility	Cost Millions Estimated	Trainer	Year	Cost of FAA Annual Fire Day Estimate FY 2002 (estimated)
Boston, Massport, Mass.	FLH	8.5	Pit	1997	No Charge * *2
Cincinnati, Greater Kentucky	FLH	9	Safe,& Pit	1997 Upgraded	No Charge * *2
Chicago, MI	Propane	12.5	SAFT & Pit	1997	No Charge *3
Columbia, SC	Propane	11	SAFT & Pit	1994	$325
Dallas Fort Worth, TX	Propane	16	SAFT & Pit	1990	$600
Detroit, MI	Propane	14	SAFT & Pit	1997	$350 *2
Duluth, MN	Propane	24	SAFT & Pit	1991	$590
Dulles, Washington, DC	Propane	16	SAFT & Pit	1997	No Charge * *2
Fayetteville, NC	Propane	7.2	Pit	1990	$225
Helena, MT	Propane	9	Pit	1997	$295
JFK Airport, NY	Propane	15	Pit, Safe Under Construction	1999	Limited Operation
Lexington, KY	Propane	12.5	SAFT & Pit	1997	$315
Los Angeles, California	FLH	24 *4	Pit	2000	Limited Operation
Ocala, FL	Propane Closed	11.5	SAFT & Pit	1998	Closed $295
Philadelphia, Pa.	Propane	11	Pit	2004	$375 Pending
Pittsburgh, PA	Propane	14	SAFT & Pit	1999	$365
Norfolk International, Va.	FLH	10	Pit	2002	No Charge *2
Missouri Department of Aviation	Propane	1.2	Mobile	1999	Transportation Fee Varied
Moses Lake, Washington	Propane	14			$300
Rochester, NY	Propane	16	SAFT & Pit	2000	$365
Virginia Department of Transportation	Propane	1.1	Mobile	1998	Transportation Fee Varied
Reno, Nevada	Propane		SAFT & Pit	2005 ?	Design Phase
San Bernadine, California	Propane	12	SAFT & Pit	Pending	Not Open
T. L. Green, New Hampshire	Propane	12	SAFT & Pit	2002	$375

**   Allow limited mutual aid training at no charge.*
**2 Allow Limited Use by Other FAA Airports*
**3 Charged DOD, USA*
**4 Included Major Cleanup Cost of Old Facility*